CLAIMS

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. An image device with a photosensor comprising:

at least one isolation trench provided in a substrate having a first conductivity type, said substrate having a first dopant concentration; and

a doped region having said first conductivity type surrounding at least a portion of said trench in said substrate, said doped region having a second dopant concentration.

2. An image device as in claim 1, wherein said trench comprises a dielectric material.

3. An image device as in claim 2, wherein said dielectric material is selected from at least one of SiO, SiO_2, oxynitride, silicon nitride, and silicon carbide.

4. An image device as in claim 1, wherein said trench is a shallow trench isolation region.

5. An image device as in claim 2, wherein said dielectric material is a high density plasma oxide.

6. An image device as in claim 1, wherein said first conductivity is a p-type conductivity.

7. An image device as in claim 6, wherein said doped region has an implant dose of from approximately 3.0×10^{11} atoms/cm^2 to approximately 3.0×10^{13} atoms/cm^2.

8. An image device as in claim 7, wherein said doped region has an implant dose of from approximately 5.0×10^{11} atoms/cm^2 to approximately 6.0×10^{12} atoms/cm^2.

9. An image device as in claim 1, wherein said photosensor is a photodiode formed adjacent to said doped region and trench, said photodiode having a p-type region and an n-type region .

10. An image device as in claim 9, wherein said p-type region has an implant dose of from approximately 3.0×10^{12} atoms/cm^2 to approximately 1.0×10^{14} atoms/cm^2.

11. An image device as in claim 10, wherein said p-type region has an implant dose of from approximately 5.0×10^{12} atoms/cm^2 to approximately 4.0×10^{13} atoms/cm^2.

12. An image device as in claim 9, wherein said n-type region is approximately less than 0.30μ away from said trench and doped region.

13. An image device as in claim 12, wherein said n-type region is approximately 0.15μ to approximately 0.00μ away from said trench and doped region.

14. An image device as in claim 1, wherein said substrate has a p-type implant concentration of from about 1.0×10^{14} atoms/cm^3 to about 1.0×10^{16} atoms/cm^3.

15. An image device as in claim 14, wherein said substrate has a p-type implant concentration of from about 5.0×10^{14} atoms/cm^3 to about 3.0×10^{15} atoms/cm^3.

16. An image device as in claim 1, further comprising a p-well region located beneath said trench and doped region, said p-well region having an implant dose of from about 5.0×10^{11} atoms/cm^2 to about 5.0×10^{13} atoms/cm^2.

17. An image device as in claim 16, wherein said p-well region has an implant dose of from about 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

18. An image device as in claim 1, wherein said image device is a CCD imager.

19. An image device as in claim 1, wherein said image device is a CMOS imager.

20. An image device as in claim 1, wherein said photosensor is one of a photoconductor or photogate.

21. An image device as in claim 9, wherein said photodiode is a pnp photodiode.

22. An image structure comprising:

a trench isolation region surrounded at least in part by a first doped region with a first conductivity type having a first impurity implant dose, wherein said first doped region is surrounded by a second doped region of said first conductivity type having a second impurity dose implant concentration; and

a charge collection region with a second conductivity type formed to be approximately less than 0.30μ away from said trench isolation region.

23. A structure as in claim 22, wherein said first conductivity type is p-type conductivity.

24. A structure as in claim 22, wherein said first impurity dose implant concentration is in the range from approximately 3.0×10^{11} atoms/cm^2 to approximately 3.0×10^{13} atoms/cm^2.

25. A structure as in claim 24, wherein said first impurity dose implant concentration is in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 6.0×10^{12} atoms/cm^2.

26. A structure as in claim 22, wherein said second doped region is a p-well region.

27. A structure as in claim 26, wherein said second impurity implant dose is in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 5.0×10^{13} atoms/cm^2.

28. A structure as in claim 27, wherein said second impurity implant dose is in the range from approximately $1.0x10^{12}$ atoms/cm^2 to approximately $1.0x10^{13}$ atoms/cm^2.

29. A structure as in claim 22, wherein said second doped region is a p-type substrate region.

30. A structure as in claim 29, wherein said second impurity implant concentration is in the range from approximately $1.0x10^{14}$ atoms/cm^3 to approximately $1.0x10^{16}$ atoms/cm^3.

31. A structure as in claim 30, wherein said second impurity implant concentration is in the range from approximately $5.0x10^{14}$ atoms/cm^3 to approximately $3.0x10^{15}$ atoms/cm^3.

32. A structure as in claim 22, wherein said first doped region surrounds the sidewalls and bottom of said trench isolation region.

33. A structure as in claim 22, wherein said second conductivity is n-type conductivity.

34. A structure as in claim 22, wherein said charge collection region is formed to be approximately 0.15μ to approximately 0.00μ away from said trench isolation region.

35. A structure as in claim 22, further comprising a pinned surface layer with p-type conductivity formed over said charge collection region, said pinned surface layer is formed with an implant dose of from approximately 3.0×10^{12} atoms/cm^2 to approximately 1.0×10^{14} atoms/cm^2.

36. A structure as in claim 22, wherein said implant dose is in the range from approximately 5.0×10^{12} atoms/cm^2 to approximately 4.0×10^{13} atoms/cm^2.

37. A structure as in claim 22, wherein said image structure is a CCD imager.

38. A structure as in claim 22, wherein said image structure is a CMOS imager.

39. A structure as in claim 22, wherein said image structure comprises a photodiode, photogate or photoconductor.

40. A structure as in claim 22, wherein said image structure comprises a pnp photodiode.

41. A photodiode structure comprising:

a first doped region having a first conductivity type formed in a substrate, said first doped region in contact with a second doped region having said first conductivity type;

a third doped region with a second conductivity type that accumulates photo-generated charge formed beneath said first doped region and adjacent to said second doped region; and

a fourth doped region having said first conductivity type formed at least in part beneath said second doped region. .

42. The structure of claim 41, wherein said first conductivity type is p- type and said second conductivity type is n- type.

43. The structure of claim 41, wherein said first doped region has an implant dose in the range from approximately $3.0x10^{12}$ atoms/cm^2 to approximately $1.0x10^{14}$ atoms/cm^2.

44. The structure of claim 43, wherein said first doped region has an implant dose in the range from approximately 5.0×10^{12} atoms/cm^2 to approximately 4.0×10^{13} atoms/cm^2.

45. The structure of claim 41, wherein said second doped region has an implant dose in the range from approximately 3.0×10^{11} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

46. The structure of claim 45, wherein said second doped region has an implant dose in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 6.0×10^{12} atoms/cm^2.

47. The structure of claim 41, wherein said third doped region has an implant dose in the range from approximately 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{14} atoms/cm^2.

48. The structure of claim 47, wherein said third doped region has an implant dose in the range from approximately 2.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

49. The structure of claim 41, wherein said fourth doped region has an implant concentration in the range from approximately 1.0×10^{14} atoms/cm^3 to approximately 1.0×10^{16} atoms/cm^3.

50. The structure of claim 49, wherein said third doped region has an implant concentration in the range from approximately 5.0×10^{14} atoms/cm^3 to approximately 3.0×10^{15} atoms/cm^3.

51. The structure of claim 41, further comprising a fifth doped region having said first conductivity type formed at least in part under said second doped region.

52. The structure of claim 51, wherein said fifth doped region has an implant dose in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 5.0×10^{13} atoms/cm^2.

53. The structure of claim 52, wherein said fifth doped region has an implant dose in the range from approximately 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

54. The structure of claim 41, wherein said first doped region and fourth doped region are electrically connected by said second doped region.

55. The structure of claim 51, wherein said first doped region and fifth doped region are electrically connected by said second doped region.

56. The structure of claim 41, wherein said third doped region is a charge collection region formed approximately less than 0.30μ away from said second doped region.

57. The structure of claim 41, wherein said photodiode structure is part of a CMOS imager.

58. The structure of claim 41, wherein said photodiode structure is part of a CCD imager.

59. The structure of claim 41, wherein said second doped region surrounds at least a portion of a trench isolation region.

60. The structure of claim 41, wherein said photodiode structure is a p-n-p photodiode.

61. The structure of claim 41, wherein said photodiode structure is an n-p-n photodiode.

62. A method of forming an image device with a photosensor, said method comprising:

forming at least one trench isolation region filled with a dielectric material in a semiconductor substrate having a first conductivity type, said substrate having a first dopant concentration; and

forming a doped region having said first conductivity type around at least a portion of said trench in said substrate, said doped region having a second dopant concentration.

63. A method as in claim 62, wherein said dielectric material is selected from at least one of SiO, SiO_2, oxynitride, silicon nitride, and silicon carbide.

64. A method as in claim 62, wherein said trench isolation region is a shallow trench isolation region.

65. A method as in claim 62, wherein said dielectric material is a high density plasma oxide.

66. A method as in claim 62, wherein said first conductivity type is p-type conductivity.

67. A method as in claim 62, wherein said doped region is formed by an implant dose in the range from approximately 3.0×10^{11} atoms/cm^2 to approximately 3.0×10^{13} atoms/cm^2.

68. A method as in claim 67, wherein said doped region is formed by an implant dose in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 6.0×10^{12} atoms/cm^2.

69. A method as in claim 67, wherein said implant dose is conducted with an implant energy in the range of from approximately 2 keV to approximately 50 keV.

70. A method as in claim 69, wherein said implant dose is conducted with an implant energy in the range of from approximately 5 keV to approximately 20 keV.

71. A method as in claim 62, wherein said doped region is formed by a blanket implant.

72. A method as in claim 62, wherein said doped region is formed by a masked implant.

73. A method as in claim 62, wherein said doped region is formed by an angled implant.

74. A method as in claim 73, wherein said angled implant is conducted with an angle that ranges from about 0° to about 35°.

75. A method as in claim 62, wherein said photosensor is a photodiode formed adjacent to said doped region and trench, said photodiode having a p-type region and an n-type region.

76. A method as in claim 75, wherein said p-type region has an implant dose of from approximately $3.0x10^{12}$ atoms/cm^2 to approximately $1.0x10^{14}$ atoms/cm^2.

77. A method as in claim 76, wherein said p-type region has an implant dose of from approximately $5.0x10^{12}$ atoms/cm^2 to approximately $4.0x10^{13}$ atoms/cm^2.

78. A method as in claim 75, wherein said n-type region is a charge collection region formed to be less than approximately 0.30μ away from said trench and doped region, said n-type region being formed underneath said p-type region.

79. A method as in claim 62, wherein said substrate is formed with an implant concentration of from approximately $1.0x10^{14}$ atoms/cm^3 to approximately $1.0x10^{16}$ atoms/cm^3.

80. A method as in claim 79, wherein said substrate is formed with an implant concentration of from approximately $5.0x10^{14}$ atoms/cm^3 to approximately $3.0x10^{15}$ atoms/cm^3.

81. A method as in claim 62, further comprising a p-well region formed beneath said trench and said doped region, said p-well region having an implant dose of from approximately $5.0x10^{11}$ atoms/cm^2 to approximately $5.0x10^{13}$ atoms/cm^2.

82. A method as in claim 81, wherein said p-well region is formed with an implant dose of from approximately 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

83. A method as in claim 62, wherein said image device is a CCD imager.

84. A method as in claim 62, wherein said image device is a CMOS imager.

85. A method as in claim 62, wherein said photosensor is one of a photoconductor or photogate.

86. A method of forming an image structure, said method comprising:

forming at least one trench isolation region;

forming a first doped region with a first conductivity type around at least a portion of said trench isolation region, said first doped region having a first impurity dose implant concentration;

forming a second doped region with said first conductivity type at least in part around said first doped region, said second doped region having a second impurity dose implant concentration; and

forming a charge collection region with a second conductivity type adjacent to said first doped region, said charge collection region formed to be approximately less than 0.30μ away from said trench isolation region.

87. A method as in claim 86, wherein said first conductivity type is p-type conductivity.

88. A method as in claim 86, wherein said first impurity implant dose is in the range from approximately $3.0x10^{11}$ atoms/cm^2 to approximately $3.0x10^{13}$ atoms/cm^2.

89. A method as in claim 88, wherein said first impurity implant dose is in the range from approximately $5.0x10^{11}$ atoms/cm^2 to approximately $6.0x10^{12}$ atoms/cm^2.

90. A method as in claim 88, wherein said implant dose is conducted with an implant energy in the range of from approximately 2 keV to approximately 50 keV.

91. A method as in claim 90, wherein said implant dose is conducted with an implant energy in the range of from approximately 5 keV to approximately 20 keV.

92. A method as in claim 86, wherein said second doped region is a p-well region.

93. A method as in claim 92, wherein said p-well region is formed with an implant dose in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 5.0×10^{13} atoms/cm^2.

94. A method as in claim 93, wherein said p-well region is formed with an implant dose in the range from approximately 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

95. A method as in claim 86, wherein said second doped region is a p-type substrate region.

96. A method as in claim 95, wherein said p-type substrate region is formed with an implant concentration in the range from approximately 1.0×10^{14} atoms/cm^3 to approximately 1.0×10^{16} atoms/cm^3.

97. A method as in claim 96, wherein said p-type substrate region is formed with an implant concentration in the range from approximately 5.0×10^{14} atoms/cm^3 to approximately 3.0×10^{15} atoms/cm^3.

98. A method as in claim 86, wherein said first doped region is formed to surround the sidewalls and bottom of said trench isolation region.

99. A method as in claim 86, wherein said second conductivity type is n- type conductivity.

100. A method as in claim 86, further comprising forming a pinned surface layer with p-type conductivity over said charge collection region, said pinned surface layer formed with an implant dose in the range from approximately 3.0×10^{12} atoms/cm^2 to approximately 1.0×10^{14} atoms/cm^2.

101. A method as in claim 100, wherein said implant dose is in the range from approximately 5.0×10^{12} atoms/cm^2 to approximately 4.0×10^{13} atoms/cm^2.

102. A method as in claim 86, wherein said image structure is formed to be a CCD imager.

103. A method as in claim 86, wherein said image structure is formed to be a CMOS image.

104. A method as in claim 86, wherein said image structure comprises a photodiode, photogate or photoconductor.

105. A method as in claim 86, wherein said first doped region is formed by a blanket implant.

106. A method as in claim 86, wherein said first doped region is formed by a masked implant.

107. A method as in claim 86, wherein said first doped region is formed by an angled implant.

108. A method as in claim 107, wherein said angled implant is conducted with an angle that ranges from about 0° to about 35°.

109. A method of forming a photodiode structure, said method comprising:

forming a first doped region having a first conductivity type in a semiconductor substrate;

forming a second doped region having said first conductivity type adjacent to said first doped region;

forming a third doped region with a second conductivity type for accumulating photo-generated charge beneath said first doped region and adjacent to said second doped region; and

forming a fourth doped region having said first conductivity type at least in part beneath said second doped region. .

110. The method of claim 109, wherein said first conductivity type is p- type and said second conductivity type is n- type.

111. The method of claim 109, wherein said first doped region is formed with an implant dose in the range from approximately 3.0×10^{12} atoms/cm^2 to approximately 1.0×10^{14} atoms/cm^2.

112. The method of claim 111, wherein said implant dose is in the range from approximately 5.0×10^{12} atoms/cm^2 to approximately 4.0×10^{13} atoms/cm^2.

113. The method of claim 109, wherein said second doped region is formed with an implant dose in the range from approximately 3.0×10^{11} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

114. The method of claim 113, wherein said implant dose is in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 6.0×10^{12} atoms/cm^2.

115. The method of claim 109, wherein said third doped region is formed with an implant dose in the range from approximately 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{14} atoms/cm^2.

116. The method of claim 115, wherein said implant dose is in the range from approximately 2.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

117. The method of claim 109, wherein said fourth doped region is formed with an implant concentration in the range from approximately 1.0×10^{14} atoms/cm^3 to approximately 1.0×10^{16} atoms/cm^3.

118. The method of claim 117, wherein said implant concentration is in the range from approximately 5.0×10^{14} atoms/cm^3 to approximately 3.0×10^{15} atoms/cm^3.

119. The method of claim 109, further comprising forming a fifth doped region having said first conductivity type at least in part under said second doped region.

120. The method of claim 119, wherein said fifth doped region is formed with an implant dose in the range from approximately 5.0×10^{11} atoms/cm^2 to approximately 5.0×10^{13} atoms/cm^2.

121. The method of claim 120, wherein said implant dose is in the range from approximately 1.0×10^{12} atoms/cm^2 to approximately 1.0×10^{13} atoms/cm^2.

122. The method of claim 109, wherein said second doped region electrically connects said first doped region and fourth doped region.

123. The method of claim 119, wherein said second doped region electrically connects said first doped region and fifth doped region.

124. The method of claim 109, wherein said third doped region is a charge collection region formed approximately less than 0.30μ away from said second doped region.

125. The method of claim 109, wherein said photodiode structure is formed to be a part of a CMOS imager.

126. The method of claim 109, wherein said photodiode structure is formed to be a part of a CCD imager.

127. The method of claim 109, further comprising forming a trench isolation region in said substrate, wherein said second doped region surrounds at least a portion of said trench isolation region.

128. The method of claim 109, wherein said photodiode structure is formed to be a p-n-p photodiode.

129. The method of claim 109, wherein said photodiode structure is formed to be an n-p-n photodiode.

130. A method as in claim 109, wherein said second doped region is formed by a blanket implant.

131. A method as in claim 109, wherein said second doped region is formed by a masked implant.

132. A method as in claim 109, wherein said second doped region is formed by an angled implant.

133. A method as in claim 132, wherein said angled implant is conducted with an angle that ranges from about 0° to about 35°.

134. A processing system comprising: (i) a processor; and (ii) an imager pixel device coupled to said processor, said imager pixel device comprising a photosensor, said photosensor comprising:

at least one isolation trench provided in a substrate having a first conductivity type, said substrate having a first dopant concentration; and

a doped region having said first conductivity type surrounding at least a portion of said trench in said substrate, said doped region having a second dopant concentration.

135. A processing system comprising: (i) a processor; and (ii) an imager structure coupled to said processor, said imager structure comprising:

a trench isolation region surrounded at least in part by a first doped region with a first conductivity type having a first impurity implant dose, wherein said first doped region is surrounded by a second doped region of said first conductivity type having a second impurity dose implant concentration; and

a charge collection region with a second conductivity type formed to be approximately less than 0.30μ away from said trench isolation region.

136. A photosensitive pixel comprising:

a p-n-p photodiode comprising an n-type charge collection region formed in a p-type substrate and a p-type surface region located above said charge collection region, said p-type substrate having a first implant dose and said p-type surface region having a second implant dose;

an isolation trench region laterally spaced apart by less than approximately 0.30μ from said charge collection region; and

a doped p-type implant region surrounding at least a portion of said isolation trench region, wherein said doped p-type implant region has a third implant dose.